ART. XXIII. *MIACIS GRACILIS*, A NEW CARNIVORE FROM THE UINTA EOCENE

By John Clark

Plates XXXIV-XXXVII

More or less fragmentary specimens of several Miacid genera, especially of *Uintacyon*, are known from the Uinta. The genus *Miacis* itself, however, is very poorly represented in collections. Especial interest attaches to the two specimens described in this paper, therefore, because the dentition and most of the limb bones are very well preserved. If, as Matthew supposed, the genus *Miacis* is directly ancestral to *Pseudocynodictis* (*Cynodictis*), this species might represent an important connecting link between the two. For these reasons, the osteology of the new species will be described at some length.

I am indebted to Mr. J. LeRoy Kay, of the Carnegie Museum, for lending me the new specimens for study; to Dr. Walter Granger of the American Museum of Natural History, for lending several specimens for comparison; and to Drs. Granger and Simpson, and several other members of the American Museum staff, for their helpfulness and patience during my several visits to the Museum in the course of this study. The illustrations were drawn by Mr. Sydney Prentice of the Carnegie Museum.

Miacis gracilis sp. nov.

Type: Carnegie Museum no. 11900; skull, lower jaws, scapula, humerus, radius, ulna, femur, tibia, fibula, most of pes, fragmentary vertebræ, pelvis, and ribs.

Referred specimen: Carnegie Museum no. 12063; consisting of partial skull with good palate, and lower jaws.

Horizon: (Type)—Horizon C, Uinta Eocene; (referred)—C., Uinta Eocene.

Locality: type and referred specimens; 7 miles east and south of Myton, Uinta County, Utah.

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Specific characters: taken only from the type. The characters of the referred specimen will be noted in the discussion.

(1) Differs from *M. parvivorus* in having the paraconid of M_2 low, relative to the protoconid, and having no cingular cuspule, while in *M. parvivorus* the paraconid is high, and the cingulum anterior to the protoconid is drawn into a tiny cuspule.

(2) Differs from *M. medius* in that the C, M^2, and M^3 are almost twice as large in *M. medius* as in *M. gracilis*, although the cheek-tooth rows are about of the same length. M^2 and M^3 of *M. medius* are sharply cusped, while in *M. gracilis* the cusps are low, almost extinct. M^1 of *M. medius* has a broad external cingular table at the postero-external corner of the tooth, while the cingulum is close to the metacone in *M. gracilis*.

(3) Differs from *M. latidens* in having the cingulum of M^1 close to the metacone, and the cingulum prominent and continuous internally while in *M. latidens* there is a broad postero-external table and the internal cingulum is low and discontinuous. Also, M^2 of *M. latidens* is almost as broad transversely as is M^1, while in *M. gracilis*, M^2 is markedly reduced. M_2 of *M. latidens* is somewhat larger than M_2 of *M. gracilis*, and M_3 is twice as large as the corresponding tooth in *M. gracilis*.

(4) The chief differences between *M. exiguus* and *M. gracilis* are proportional. Total length of the lower cheek-tooth dentition in *M. exiguus* is less than ¾ that in *M. gracilis*, while M_2 of *M. exiguus* is almost as large, and M_3 fully as large, as the corresponding teeth in *M. gracilis*.

(5) The referred specimen of *M. sylvestris* in the American Museum (A.M.N.H. no. 13071), has the molars approximately half as large as the corresponding teeth in *M. gracilis*. I have not had the opportunity to make a direct comparison with the type in this case.

(6) The type of *M. washakius* has the broad postero-external cingular table on M^1, which occurs also in *M. medius* and *M. latidens*, and is not present in *M. gracilis*. Also, M^2 of *M. washakius* is extremely short antero-posteriorly, and very low-crowned, while in *M. gracilis* it is longer and higher crowned.

(7) In the fragmentary type of *Mimocyon longipes* Peterson, sometimes referred to *Miacis*, each bone is almost exactly twice as large as the corresponding bone in *M. gracilis*. In the absence of good characters for comparison in *Mimocyon longipes*, this seems a valid basis for a specific distinction between the two.

(8) The type of *Prodaphoenus* (?) *robustus* Peterson, referred by Hay[1] to *Miacis*, is twice as large as *M. gracilis*, and has a heavy mandible with a distinct chin, while in *M. gracilis* the mandible is slender and tapering.

[1] Hay, O. P., Second Bibliog. and Cat. of the Fossil Vertebrata of North America. Carnegie Inst. of Wash., Publication 390, 1930, Vol. II, p. 485.

(9) The extremely fragmentary type of *M. uintensis* is a third larger than *M. gracilis*, has the mandible massive, and P_4 fully twice the size of P_4 in *M. gracilis*.

(10) *Miacis hargeri* has the broad cingular table on M^1, internal cingulum discontinuous, and M_3 relatively unreduced, while *M. gracilis* has the cingulum closely applied to the metacone, internal cingulum of M^1 complete, and M_3 almost vestigial. I have not had the opportunity of examining the type of *M. hargeri;* this distinction is, therefore, based only on descriptions and figures.

(11) The fragmentary specimen described by Schlaikjer[2] as *Miacis matthewi* differs from *M. gracilis* chiefly in size, as it is almost or quite twice as large as *M. gracilis*. The limited number of characters exhibited by the type of *Miacis matthewi* makes comparison extremely difficult in this case. However, *M. gracilis* is sufficiently different in size to warrant a specific distinction in the absence of other evidence, so the relationships of "*M.*" *matthewi* are not of importance in the present discussion.

In brief summary: the distinctive dental characters of *Miacis gracilis* are: (1) cingulum of M^1 close to the metacone, while in most other species it is separated from the metacone by a broad table; (2) internal cingulum of M^1 complete; (3) second and third molars, both upper and lower, sharply reduced, $M^{\frac{3}{3}}$ almost to extinction.

FURTHER DESCRIPTION

Osteology: Miacis gracilis will be compared with the following specimens: *Miacis parvivorus* (A.M.N.H. no. 11496), partial skeleton, described by Matthew in the monograph on the Bridger[3]; *Miacis uintensis* (A.M.N.H. no. 1964), partial skeleton, and *Vulpavus profectus* (A.M.N.H. no. 12626), both described by Matthew[4]; *Pseudocynodictis gregarius*, Princeton Museum nos. 10493, 10944, 11012, 11382, 11432, 13137, and 13365.

The skull is so badly crushed that many important characters are lost. In size and general appearance it resembles *Vulpavus profectus;* the muzzle is slightly longer proportionally than that of *Pseudocynodictis gregarius*. As nearly as can be determined, the upper contour

[2] Schlaikjer, E. M., Contributions to the Stratigraphy and Paleontology of the Goshen Hole Area, Wyoming, III, a New Basal Oligocene Formation. Bull. Mus. Comp. Zool. Harvard, vol. 76, 1935, p. 77.

[3] Matthew, W. D., The Carnivora and Insectivora of the Bridger Basin, Memoirs, American Museum of Natural History, Vol. IX, 1905-09, p. 365.

[4] Matthew, W. D., *ibid.*, pp. 371, 382.

of the skull follows more closely the slight curve of *V. profectus* than the more highly convex line of *P. gregarius*, especially in the facial region.[5] The sagittal crest is extremely low.

The basicranial foramina resemble those of *Vulpavus* and *Pseudocynodictis* in all essential respects. The mastoid process is stronger than that of *Vulpavus*, while the paroccipital process is very decidedly weaker, which gives the extra-otic region a distinctly cynodictoid aspect.

The tympanic cavity is more elongate antero-posteriorly than that of *Vulpavus;* the basisphenoidal and anterior squamosal portions of the rim are slightly elevated, as if for reception of a tympanic bulla. No portion of either bulla, if such ever existed, is in place. However, there is a large, extraneous piece of bone adhering to the right alisphenoid just anterior to the inner part of the glenoid fossa, which I can interpret only as a portion of the rim of the tympanic, probably the left. If this interpretation is correct, it indicates a very important cynodictoid character not previously known in *Miacis* or, to the best of my knowledge, in any of the Miacidæ.

The characters of the upper dentition are those typical of *Miacis*. The canine is small and laniary. The premolars are well spaced; P^1 is single-rooted, P^{2-3} double-rooted. The P^1 has a tiny heel; P^2 and P^3 have a heel and a faint posterior accessory cusp, and P^4 resembles P^4 of *Pseudocynodictis* except that the external cingulum is better developed and the division of the posterior blade into two cusps, incipient in *Pseudocynodictis*, is not present.

In the molars, M^1 differs from M^1 of *Pseudocynodictis* in the development of the internal cingulum. In *M. gracilis* the cingulum is a low, continuous ridge, paralleling the base of the protocone. In *Pseudocynodictis*, the cingulum swings far out from the base of the protocone and is produced into a strong hypocone. Also, in many specimens of *Pseudocynodictis*, the antero-external angle of M^1 is not so sharply extended as it is in *M. gracilis*. The internal cingulum of M^2 is stronger in *Pseudocynodictis* than in *M. gracilis*, and *M. gracilis* retains a vestigial M^3 which does not occur in *Pseudocynodictis*.

The dentition of the co-type of *Procynodictis vulpiceps* (A.M.N.H. no. 2514), possesses characters midway between the two. In general it resembles *M. gracilis;* however the external cingula are obsolete, the

[5] Scott, W. B., Notes on the Canidæ of the White River Oligocene. Trans. Amer. Philos. Soc., XIX, 1898, p. 368.

internal cingulum of M^1 is drawn away from the protocone into a rudimentary hypocone, and the other co-type (A.M.N.H. no. 2506) shows that M^3 was not present. This intermediate anatomical facies should not be used as *a priori* evidence of phylogenetic relationships, because, if the localities given on the field labels are correct, *Procynodictis vulpiceps* occurred at a lower horizon within the Uinta than did *M. gracilis*.

The mandible of *M. gracilis* differs from that of *Pseudocynodictis* in a few simple characters. The premolars are spaced rather than in contact; they have not undergone such extreme lateral compression as those of *P. gregarius*, and the anterior accessory cusps are anterointernal rather than directly anterior. The anterior mental foramen lies below the diastema between P_1 and P_2 in *M. gracilis*, and below P_1 in *Pseudocynodictis*. Otherwise, the mandible of *M. gracilis* possesses only characters which appear within the limits of variation of *Pseudocynodictis*.

Aside from the dental characters, which were adequately discussed by Matthew in his original description, the mandible of *Vulpavus profectus* differs from that of *M. gracilis* in several ways. The tooth row of *V. profectus* is a fourth shorter than that of *M. gracilis*, although the mandibles are of the same length; correspondingly, of course, the ascending ramus is much broader and more recurved than that of *M. gracilis*. The dental ramus is of the same height throughout, while in *M. gracilis* the jaw swells to a notable angle below M_1. Finally, *V. profectus* exhibits a slight symphyseal angle or chin, which is totally absent in *M. gracilis*.

Vertebral Column: the atlas, most of the cervicals, and many thoracics and lumbars are represented; all except the atlas in so crushed and fragmentary a condition that distinctive characters are obliterated. The posterior opening of the vertebrarterial canal in the atlas opens directly backward, rather than slightly on the dorsal

FIG. 1. *Miacis gracilis* Clark, Atlas vertebra. (1) Dorsal, (2) lateral, and (3) anterior views.

side of the transverse process as does the canal of *Pseudocynodictis*. Otherwise the atlas is similar to that of *Pseudocynodictis*.

Fore Limb: the scapula is low, with the blade rounded and almost lobate. For the lower fourth of its course, the spine practically forms the posterior border of the scapula, with the ear-shaped post-scapular blade extending as a flat lobe from the upper three-fourths of the spine. The pre-scapular blade consists of a large, anteriorly directed lower lobe, and a smaller upper lobe whose rim is directly confluent with that of the post-scapular lobe along the vertebral border of the bone. The spine itself is seriously damaged, but there is evidence of a long acromion and a large metacromion, as in *Pseudocynodictis*. The neck of the scapula is broad, the glenoid cavity long antero-posteriorly, and the coracoid process well developed.

Humerus: several points of close similarity with *Pseudocynodictis* have been mentioned in the discussion thus far. In the humerus, radius, and ulna, the similarity is so great that discussion becomes almost impossible. The smallest details of proportion, relative development, and minor surface topography in the humerus of *Pseudocynodictis* find their almost perfect homologues in the humerus of *M. gracilis*. The head of the humerus of *M. gracilis* is slightly broader transversely than that of *Pseudocynodictis*. Otherwise, no differences are apparent.

Correspondingly, the humerus of *M. gracilis* differs notably from the humerus in other species of the genus, and exceedingly from the humerus of *Vulpavus profectus*. *Miacis parvivorus* and, according to Matthew[6], "all the species" have "a long, prominent, abruptly ending deltoid crest, high supinator crest." The deltoid crest of *M. gracilis* is long, but it is very weakly developed and its distal termination grades imperceptibly into the shaft of the humerus. The supinator crest is, relative to the other species, extremely low and weak. The inner flange of the ulnar facet of the trochlea is high and sharp, rather than low and rounded as in almost all other Miacidæ.

The differences between the humerus just described and that of *Vulpavus profectus*, with its generally massive build, high, powerful, sharply terminated deltoid crest, and tremendous supinator ridge, are obvious.

Radius: the radius and ulna bear almost as many cynodictoid resemblances as do the humerus. The radius has the same curvature,

[6] Matthew, W. D., *loc. cit.*, p. 363.

position of bicipital tubercle, and shape of capitellum as has the radius of *Pseudocynodictis*. The distal tendinal sulci are even less developed than those of *Pseudocynodictis*. Scott states[7] that in the latter genus "the carpal facet . . . . does not extend over upon the styloid process, from which it is separated by a broad and deep notch." In the two radii of *Pseudocynodictis* at hand, and also in *M. gracilis*, this is not the case; there is no notch, and the carpal facet does extend on to the styloid process.

The chief characters differentiating the radius of *M. gracilis* from that of *M. parvivorus* are its much straighter shaft, more posteriorly situated bicipital tubercle, and more elongate capitellum. All of the bones of *M. parvivorus* are, of course, much smaller than those of *M. gracilis*, and as this character is obvious it will not be mentioned separately for each bone.

The radius of *Vulpavus profectus* is massive, strongly bowed, with a sub-circular capitellum and a well-marked, concave distal ulnar facet extending as a narrow band from the back almost to the front on the inner face of the distal articular expansion. The distal tibial facet on the radius of *M. gracilis* appears as a tiny, ill-defined surface, occupying less than one-third the width of the bone.

Ulna: unfortunately, the specimens of *Pseudocynodictis* at hand do not have the ulnæ well preserved. However many essential features are preserved, and some comparison is possible.

The olecranon of *M. gracilis* is very similar, both in topography and proportions, to that of *Pseudocynodictis*. The sigmoid notches are cut to corresponding depths, but the upper and lower facet surfaces diverge at an angle slightly more than 60° in *M. gracilis*, and about 50°—55° in *Pseudocynodictis*. The shaft is laterally compressed proximally, and is trihedral distally, like that of *Pseudocynodictis*. The distal radial facets of both are extremely reduced.

The sigmoid notch in *M. parvivorus* is very much shallower than that of *M. gracilis*, and the upper and lower facet surfaces diverge at 90°. The shafts are similar except that the area of origin of the pronator quadratus is flat in *M. gracilis* and sharply concave in *M. parvivorus*. This concavity occurs also in the ulna of *Vulpavus profectus*, which is massive and bowed, with a shallow, open sigmoid notch and a tapering olecranon.

Unfortunately, the carpus of *M. gracilis* is not preserved.

[7] Scott, W. B., *loc. cit.*, p. 383.

Hind limb: pelvis: part of the right ilium and of the left ischium are all that has been preserved. The ventro-external ridge of the iliac peduncle is less prominent than in *Pseudocynodictis*, while the psoas tubercle is well developed. Otherwise the known parts resemble those of *Pseudocynodictis*. The iliac peduncle of *M. parvivorus* resembles that of *Pseudocynodictis* more closely than does *M. gracilis*, in the details mentioned above, although by its elongation it shows less real relationship than does *M. gracilis*.

Femur: the neck is heavier and shorter than that of *Pseudocynodictis*, and the greater trochanter is slightly higher. The lesser trochanter is

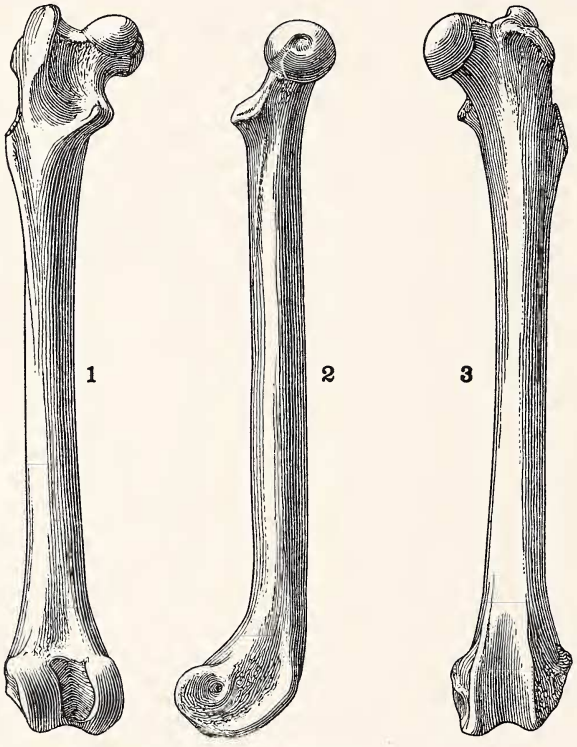


FIG. 2. *Miacis gracilis* Clark. (1) Posterior, (2) medial, and (3) anterior views of the left femur.

prominent, and the third trochanter is present but small and low. The shaft is almost perfectly straight. The distal termination of the bone is like that of *Pseudocynodictis*, with the condyles slightly crowded

together. The somewhat crushed femur of *M. parvivorus* shows no points of difference from *M. gracilis.*

Patella: Scott's description of the patella in *Pseudocynodictis*[8] can be quoted directly for *M. gracilis:* "it is a short, rather wide, thin and scale-like bone, of subquadrate more than ovate shape. The articular surface for the femur . . . . is but slightly concave proximo-distally, and even less convex transversely."

Tibia: the proximal portions of both tibiæ are so crushed that few characters are discernible. The spine is small and slightly bifid; the cnemial crest is long but quite low. The medial malleolus is large, and as wide antero-posteriorly as the tibia itself; it bears a sharp groove for the tendon of the flexor digitorum longus muscle. The distal fibular facet is plainly marked, about three-fourths as large as the facet of *Pseudocynodictis.* The distal articular surface is somewhat less deeply sulcated than that of *Pseudocynodictis,* but very much more so than *M. parvivorus* and *Vulpavus profectus.*

Fibula: I am unable to find the proximal end of the fibula of *P. gregarius,* Princeton Museum no. 11012, which Scott used in his study of the osteology of *Pseudocynodictis.* By comparison with his description, the proximal head of the fibula of *M. gracilis* seems less compressed transversely, but otherwise similar. The reduction of the shaft is about equal in the two forms. The distal head in *M. gracilis* differs from that in *Pseudocynodictis* in several quite insignificant details of relative development. The only point worthy of mention is that the lateral tubercle bounding the peroneus tertius sulcus is large and rounded in *M. gracilis,* and smaller and pointed in *Pseudocynodictis.*

Comparison with the fibula of *Vulpavus profectus* is almost fruitless, as the two are extremely different. A catalogue of differences would merely expend much time over anatomical details whose interpretation is difficult or for which no interpretation is known.

Briefly, then, the fibula of *V. profectus* has the shaft proportionally heavier, and the peroneus tertius sulcus extremely shallow, with its median bounding tubercle almost opposite the lateral tubercle rather than distal to it.

Pes: astragalus: the astragalus is similar to that of *Pseudocynodictis.* The tibial trochlea is not quite so deeply grooved as in the latter genus and in general the facet borders, sulci, and eminences fall short of its crisp distinctness of outline, but these differences are very slight. The

[8] Scott, W. B., *loc. cit.,* p. 391.

trochlear facet does not extend forward on to the neck as, according to Matthew[9], it does in *Miacis*. The inner crest is low but present, another character which is absent in *Miacis* generally.

Calcaneum: the calcaneum presents some definite points of difference from that of *Pseudocynodictis*. The tuber is almost equidimensional with the dorso-internal angle expanded, rather than being laterally compressed. The sustentaculum is actually and proportionally larger, while the sustentacular facet is a short ovoid, elongated antero-posteriorly, rather than being almost circular. A sharply demarcated sulcus curves around the externo-distal end of the area of attachment of the short plantar ligament and extends on to the face of the cuboidal facet, where it expands into a small depressed area. In *Pseudocynodictis*, a shallow, poorly marked notch in the rim of the cuboidal facet extends slightly on to the area of ligamentous attachment, and there is no depressed area on the face of the cuboidal facet.

Cuboid: I have been unable to find the cuboid in any of the specimens of *Pseudocynodictis* mentioned by Scott; the cuboid from another specimen, Princeton Museum no. 10496, is, therefore, used for comparison here.

The tendinal sulcus on the external surface is as deep as in *Pseudocynodictis*, but considerably wider. The navicular facet has a distal extension along the dorso-internal edge of the bone, which gives the facet a shape like a triangle with the distal side bent inward, rather than an irregularly ovoid shape. The plantar edge of the calcanear facet bears a wide, deep notch, in contrast to the shallow excavation in *Pseudocynodictis*. Otherwise the bones are similar.

Navicular: the navicular of *M. gracilis* is quite strikingly different from that of *Pseudocynodictis*. It is much wider transversely, and has undergone proportionately more compression antero-posteriorly. The cuboid facet is large, circular, and flat, rather than small, sub-circular, and concave. The astragalar facet is more deeply concave than that of *Pseudocynodictis*. The distal surface is like that of *Pseudocynodictis*, except that the facet for the ectocuneiform is more nearly triangular, that for the mesocuneiform is less elevated, and the interarticular sulci, especially the distal-plantar sulcus, are less sharply incised.

Ectocuneiform: the ectocuneiform is essentially similar to that of *Pseudocynodictis*. As in the other tarsal elements, all of the topog-

[9] Matthew, W. D., *loc. cit.*, p. 363.

raphy of the bones is less sharply sculptured than in the latter genus.

The mesocuneiform, the entocuneiform, and the first metatarsal are lost.

Metatarsals: of those metatarsals remaining, the fourth is longest, then in order come the third, fifth, and second. Accidental loss of the first accentuates the almost paraxonic condition of the metatarsus.

The second metatarsal is somewhat stouter than the fifth, but more slender than the third and fourth. As nearly as can be determined from the fragmentary metatarsals of *Pseudocynodictis*, it is similar to the second metatarsal in that genus. The third metatarsal is the most massive of the group, being slightly heavier than the longer fourth. It is like that of *Pseudocynodictis* save that the ectocuneiform facet is narrower transversely and the plantar process is slightly longer. The fourth metatarsal resembles that of *Pseudocynodictis*, and distally the shaft becomes transversely oval, as Scott postulated for *Pseudocynodictis*. The fifth metatarsal has the external ascending process much more reduced than that of *Vulpavus profectus*, but extremely prominent in comparison with the condition in *Canis*.

Many phalanges are preserved, but as there are none in association I have not attempted to determine their position. The ungual phalanges are very high, laterally compressed, and unfissured; on the dorsal edge, as it rises in a convex curve from the tip, is a peculiar, double flattened area, which looks like a facet for articulation of another bone. I do not know what the significance of this flattened zone might be. It is not present in *Canis*, in *Vulpavus profectus*, or in other described species of *Miacis*. I cannot find any ungual phalanges in the Princeton specimens of *Pseudocynodictis*, so direct comparison with that genus is, most unfortunately, impossible.

Characters of referred specimen: with the exception of two characters, the referred specimen is almost identical with the type. As the table of measurements shows, the tooth row of the referred specimen is distinctly shorter than that of the type; the carnassials, however, and especially the lower carnassials, are notably larger than those of the type. This difference becomes even more evident, when one compares the specimens, than a mere table of measurement can reveal.

Differences no greater than these have been used as criteria for differentiating species of *Miacis*, in the past, and ultimately a series of specimens from the type horizon and locality may demonstrate that the two at hand are representatives of two well-defined groups.

However, the manifest impossibility of determining the taxonomic significance of minor differences between two specimens, in the absence of others, leads me to describe the referred specimen, for the present, as a variant rather than a separate species. No conceivable benefit could arise from the creation of another name at this time, and a name can be applied at whatever time the need for one develops.

Conclusions: Miacis gracilis is a form intermediate in its anatomy, as it is in time, between the more typical species of *Miacis* and *Pseudocynodictis*. Its chief Miacid characters are: (1) Retention of M^3; (2) absence of the hypocone on M^1; (3) open spacing of premolars; (4) almost straight rather than curved contour of top of skull; (5) indistinct sculpturing and many details of anatomy in tarsals. Its outstanding Cynodictoid characters are: (1) presence of an ossified tympanic; (2) suppression of the deltoid and supinator ridges; (3) high, sharp ridge bounding the ulnar facet of the humerus; (4) deep sigmoid notch on the ulna; (5) relative lengthening, straightening, and delicacy of the radius and ulna; (6) ovate rather than sub-circular capitellum of the radius. Briefly, the skull, dentition, and tarsus are Miacid, while the limbs are Cynodictoid. All of the characters mentioned can be derived from earlier species of *Miacis*, and no characters have been observed which preclude an ancestral relationship to *Pseudocynodictis*. However, additional specimens must be collected and studied before any phylogenies can be considered to be more than mere suggestions.

SKULL MEASUREMENTS

	C. M. 11900	C. M. 12063	AMNH 1896	AMNH 2514	AMNH 11496
Length—incisors to basion	91.4*+				
Length—nasal tips to inion	82.6				
Bregma to inion	46.5				
Ant. orbit to post. arch	44.7				
Breadth at postorbital processes	24.8	23.0			
Breadth at postorbital constriction	13.3	15.0			
Distance, postorbital process-postorbital constriction	3.6				
Distance between infraorbital foramina	*				
Width of cranium at post. side of arch	*				
Width of lambdoid crest	17.6*				
Length of palate	42.9	44a			
Basion—postglenoid	21.7				
Postglenoid to squamoso-maxillary angle	28.8*				
Width between postglenoid tips	24.8*-				
Length of condyle	10.8				
Ant. of canine alveolus—post. of M^2	42.3	38.8		37.4a	
$\underline{PM}$ series (Measured externally)	27.8	25.8		28.1	
$\underline{M}$ series (Measured externally)	11.7	11.3			
Length of P^4 (Measured externally)	8.9	9.5		10.1	7.1
Length of M^1 (Measured externally)	6.4	6.5		6.3	3.3
Width (outside) at P—M angle	25.8-	32.0+			
Width (outside) at canines	*	14a		16.a	
Width (outside) at M^{2-3}	22.9	26.2			
Alveolar border—infraorbital foramen	3.5			3.5	
Alveolar border—lower rim of orbit	8.8				
Infraorbital foramen lies over	ant P^3	ant P^3		Post P^3	
$\underline{P}$ series—measured ant.-post.	27.0	24.6		27.0	
$\underline{M}$ series—measured ant.-post.	9.7	10.0			
Length M^1—measured ant.-post.	5.7	5.5		5.0	3.1
Width M^1	9.5	9.8		10.0	6.3

a—Approximate.
*—Crushed.
*+—Crushed, longer than originally.
*-—Crushed, shorter than originally.

LOWER JAW MEASUREMENTS

	C. M. 11900	C. M. 12063	ANNH 1896	ANNH 2514	ANNH 11496
Canine alveolus to condyle	63.3	59.1a			
Canine alveolus to M_3 alveolus (outside)	43.8	37.7a	38.7	42.0a	32.a
M_3 alveolus—condyle	23.4	22.5			
Angle to coronoid tip	30.3				
Preangular hollow to coronoid tip	28.9				
Condyle to coronoid tip	13.4				
Angle to condyle	16.0	15.2			
Height below M_1	11.4	9.7	14.7	11.4	
Base of masseteric fossa, ant.-post. (inside)	16.2				
$\overline{P}$ series	24.0	21.2		22.3	15.a
$\overline{M}$ series	15.1	15.4	17.8	16.2	12.6
Tubercular	9.4	10.3	12.8	10.0	8.8
Sectorial	29.6	27.3		27.5	19.1a
Length M_1	8.4	10.0	10.8	9.3	5.6
Mental foramina lie below	Ant P^3	Ant P^3	ant. P_3	mid P^3	? Ant P^3
Diastema	P_1–P_2	P_1–P_2		?	
Length of coronoid	10.3				

OTHER MEASUREMENTS

	C.M. 11900	AMNH 11496	AMNH 12626	AMNH 1964
HUMERUS: Length (notches)	75.6	56.6	81.0	
Width, maximum, across epicondyles	18.0	16.2	27.0	
ULNA: Length, maximum	79.6	57.0	89.4	
RADIUS: Maximum length	64.0	47.5	71.0	
FEMUR: Length (notches)	90.6	75.5		127.
TIBIA: Length, trochlea to spine	93.0	70.8	90.	116.

a—Approximate.

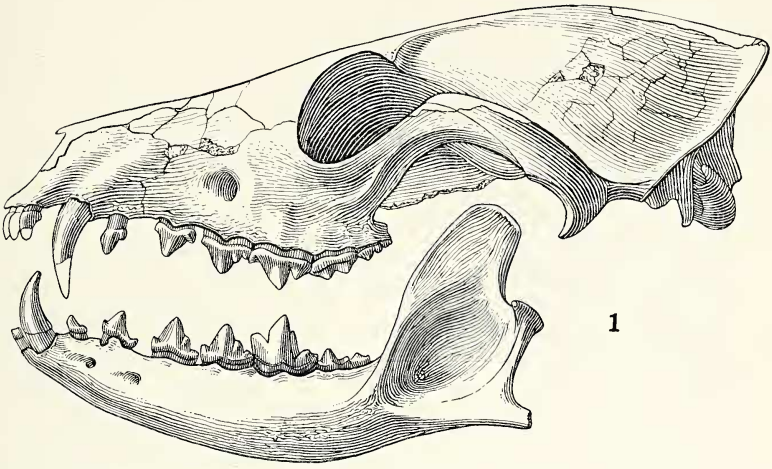
EXPLANATION OF PLATE XXXIV

Miacis gracilis Clark

FIG. 1. Skull and mandible, left side.

FIG. 2. Left lower dentition, crown view.

FIG. 3. Skull, palatal view. Note the piece of bone, possibly a portion of the left tympanic, adhering to the right alisphenoid.



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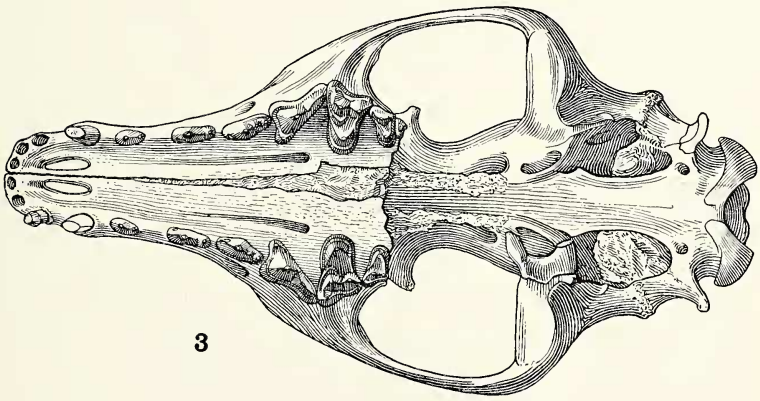

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EXPLANATION OF PLATE XXXV

Miacis gracilis Clark

FIG. 1. Right scapula, lateral view.

FIG. 2. Right ulna, anterior view.

FIG. 3. Right ulna, medial view.

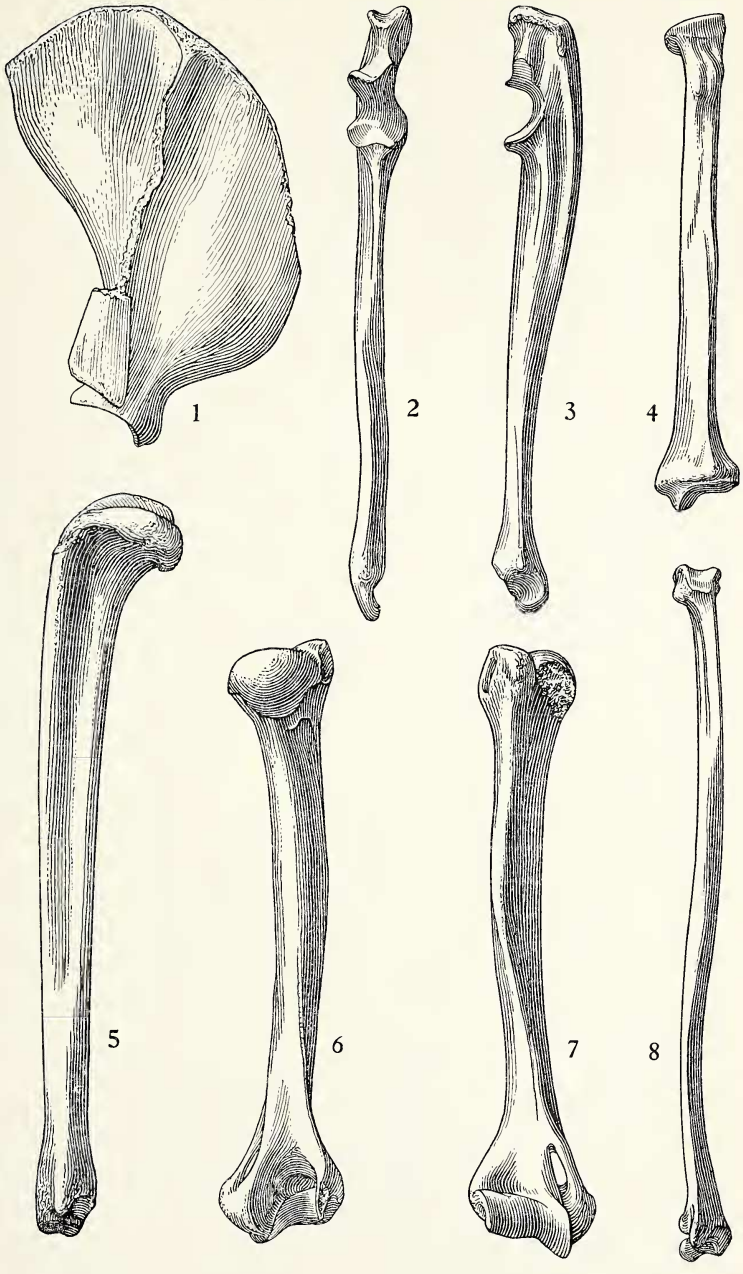
FIG. 4. Right radius, posterior view.

FIG. 5. Left tibia, medial view.

FIG. 6. Right humerus, posterior view.

FIG. 7. Right humerus, anterior view.

FIG. 8. Left fibula, posterior view.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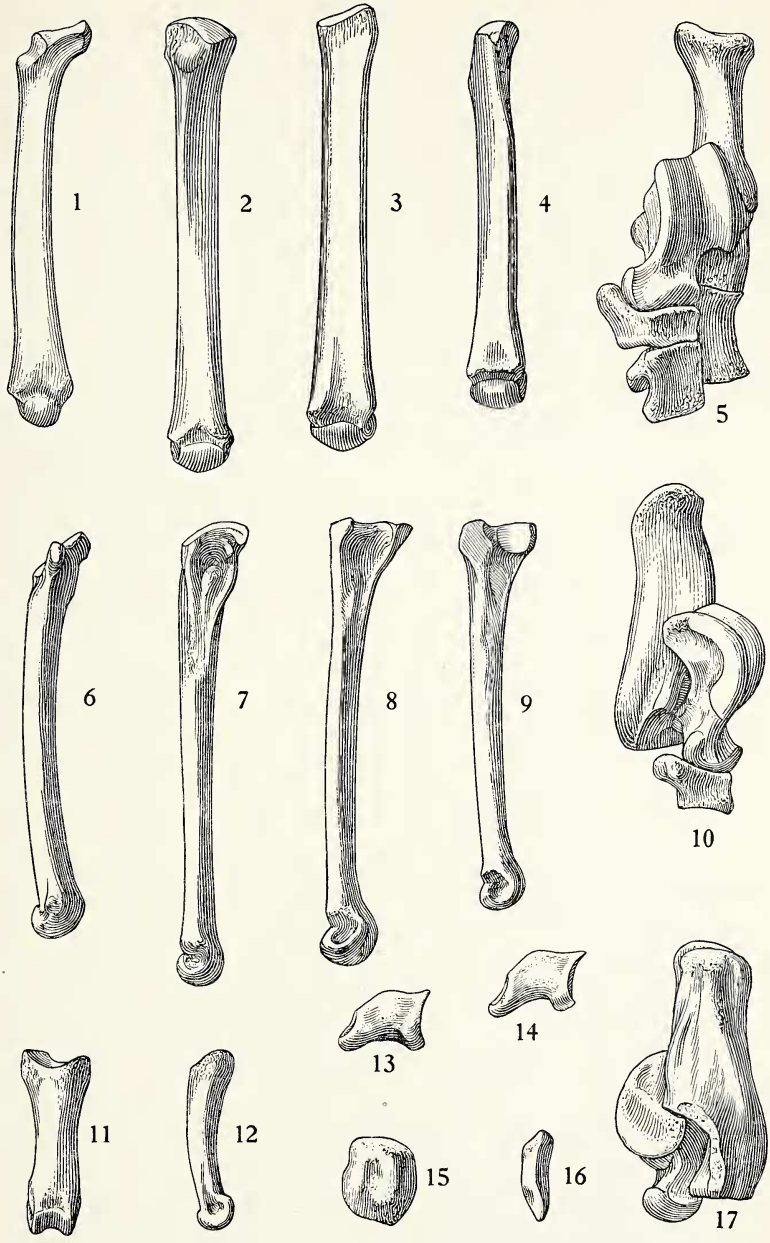
EXPLANATION OF PLATE XXXVI

Miacis gracilis Clark

All bones are from the left pes.

FIG. 1. Metatarsal V, anterior view.
FIG. 2. Metatarsal IV, anterior view.
FIG. 3. Metatarsal III, anterior view.
FIG. 4. Metatarsal II, anterior view.
FIG. 5. Tarsus, anterior or dorsal view.
FIG. 6. Metatarsal V, lateral view.
FIG. 7. Metatarsal IV, lateral view.
FIG. 8. Metatarsal III, lateral view.
FIG. 9. Metatarsal II, lateral view.
FIG. 10. Tarsus, medial view.
FIG. 11. Proximal phalanx, dorsal view.
FIG. 12. Proximal phalanx, lateral view.
FIG. 13. Ungual phalanx.
FIG. 14. Ungual phalanx.
FIG. 15. Patella, anterior aspect.
FIG. 16. Patella, lateral view.
FIG. 17. Calcaneum and astragalus, lateral view.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EXPLANATION OF PLATE XXXVII

Miacis gracilis Clark

Photographs of the skull; lateral and palatal aspects.